Standard

Electronic Equipment for Passenger Rolling Stock

Version 1.0

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Standard governance

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Document history

<table>
<thead>
<tr>
<th>Version</th>
<th>Summary of changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>First issue</td>
</tr>
</tbody>
</table>

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Preface

The Asset Standards Authority (ASA) is a key strategic branch of Transport for NSW (TfNSW). As the network design and standards authority for NSW Transport Assets, as specified in the ASA Charter, the ASA identifies, selects, develops, publishes, maintains and controls a suite of requirements documents on behalf of TfNSW, the asset owner.

The ASA deploys TfNSW requirements for asset and safety assurance by creating and managing TfNSW’s governance models, documents and processes. To achieve this, the ASA focuses on four primary tasks:

- publishing and managing TfNSW’s process and requirements documents including TfNSW plans, standards, manuals and guides
- deploying TfNSW's Authorised Engineering Organisation (AEO) framework
- continuously improving TfNSW’s Asset Management Framework
- collaborating with the Transport cluster and industry through open engagement

The AEO framework authorises engineering organisations to supply and provide asset related products and services to TfNSW. It works to assure the safety, quality and fitness for purpose of those products and services over the asset's whole-of-life. AEOs are expected to demonstrate how they have applied the requirements of ASA documents, including TfNSW plans, standards and guides, when delivering assets and related services for TfNSW.

Compliance with ASA requirements by itself is not sufficient to ensure satisfactory outcomes for NSW Transport Assets. The ASA expects that professional judgement be used by competent personnel when using ASA requirements to produce those outcomes.

About this document

This document has been issued by the ASA to provide the requirements for the conditions of operation, design, construction, components, materials and finishes and testing of electronic equipment supplied for TfNSW heavy rail and light rail passenger rolling stock.

This standard supersedes T HR RS 00126 ST Electronic Equipment for Passenger Rolling Stock, version 3.0.

The requirements in T HR RS 00126 ST, version 3.0 were specific to heavy rail. This standard amends those requirements to suit heavy rail and light rail.

This standard has been prepared by the ASA in consultation with TfNSW agencies, and industry and supplier representatives.

This document is a first issue.
Table of contents

1. Introduction .............................................................................................................................................. 6
2. Purpose .................................................................................................................................................... 6
  2.1. Scope ..................................................................................................................................................... 6
  2.2. Application ............................................................................................................................................. 6
3. Reference documents ............................................................................................................................. 6
4. Terms and definitions ............................................................................................................................. 7
5. General requirements ............................................................................................................................. 8
6. Operating conditions .............................................................................................................................. 8
  6.1. Rail operations environment .................................................................................................................. 8
  6.2. Environment conditions ......................................................................................................................... 8
  6.3. Power supply ......................................................................................................................................... 8
  6.4. Vibration and shock ............................................................................................................................... 9
7. Design of electronic equipment ............................................................................................................. 9
  7.1. Fire performance ................................................................................................................................. 10
  7.2. Equipment reliability ........................................................................................................................... 10
  7.3. Component ratings and de-rating ........................................................................................................ 10
  7.4. Adjustable components ....................................................................................................................... 10
  7.5. Component tolerances and ageing ...................................................................................................... 10
  7.6. Protection ............................................................................................................................................. 10
  7.7. Interference .......................................................................................................................................... 11
  7.8. Ventilation ............................................................................................................................................ 11
8. Construction of electronic equipment ................................................................................................ 11
  8.1. Component mounting .......................................................................................................................... 12
  8.2. Electrical connections .......................................................................................................................... 12
9. Identification .......................................................................................................................................... 13
  9.1. Equipment labelling ............................................................................................................................. 13
  9.2. Unit and sub unit mounting position .................................................................................................... 13
  9.3. Termination of screened cables .......................................................................................................... 14
10. Component identification ....................................................................................................................... 14
11. Documentation ....................................................................................................................................... 14
12. Testing .................................................................................................................................................... 14
1. **Introduction**

This document states the performance standards required of electronic equipment supplied for TfNSW heavy rail and light rail passenger rolling stock.

2. **Purpose**

This standard details the requirements of electronic equipment that are used on TfNSW passenger rolling stock to maximise electronic equipment reliability and maximise passenger safety.

2.1. **Scope**

This standard covers the conditions of operation, design, construction, components, materials and finishes and testing of electronic equipment supplied for passenger rolling stock.

2.2. **Application**

This standard applies to new heavy rail and light rail passenger rolling stock and refurbishment or modifications to existing rolling stock assets. This standard, along with the following documents, form a suite of passenger rolling stock electrical standards, which should be read in conjunction with one another:

- T HR RS 00117 ST *Electrical Circuits and Equipment for Passenger Rolling Stock*
- T LR RS 00117 ST *Electrical Circuits and Equipment for Light Rail Vehicles*
- T MU RS 00164 ST *Cables for Passenger Rolling Stock*
- T HR RS 01701 ST *Mounting and Installation of Electrical Equipment*
- T LR RS 01701 ST *Mounting and Installation of Electrical Equipment for Light Rail Vehicles*

3. **Reference documents**

The following documents are cited in the text. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document applies.

**International standards**

- EN 50121-3-2 Railway Applications – Electromagnetic Compatibility – Part 3-2: Rolling Stock – Apparatus
- EN 50128 Railway applications – Communication, signalling and processing systems – Software for railway control and protection systems
- EN 50155 Railway applications – Electronic equipment used on rolling stock
EN 60352-2 Solderless connections – Part 2: Crimped connections – General requirements, test methods and practical guidance

IEC 60571 Railway applications – Electronic equipment used on rolling stock

IEC 60605-6 Equipment reliability testing – Part 6: Tests for the validity and estimation of the constant failure rate and constant failure intensity

IEC 61188-1-1 Printed boards and printed board assemblies – Design and use – Part 1-1: Generic requirements – Flatness considerations for electronic assemblies

**Transport for NSW standards**

T HR RS 00117 ST Electric Circuits and Equipment for Passenger Rolling Stock

T HR RS 17010 ST Passenger Rolling Stock Fire Safety

T LR RS 00117 ST Electrical Circuits and Equipment for Light Rail Vehicles

T LR RS 01701 ST Mounting and Installation of Electrical Equipment for Light Rail Vehicles

T LR RS 17010 ST Light Rail Vehicle Fire Safety

T MU RS 00164 ST Cables for Passenger Rolling Stock

T MU RS 17001 ST Environmental Conditions for Rolling Stock

### 4. Terms and definitions

The following terms and definitions apply in this document:

- **ac** alternating current

- **AEO** Authorised Engineering Organisation

- **ASA** Asset Standards Authority

- **dc** direct current

- **printed board** the base material, cut to size, containing all holes and bearing at least one conductive pattern

- **SFAIRP** so as far as is reasonably practicable

- **surge** a non-periodic and relatively short positive or negative (or both) variable (voltage or current) between two steady states

- **TfNSW** Transport for NSW
5. **General requirements**

All electronic equipment provided as part of the rolling stock equipment shall comply with EN 50155 *Railway applications – Electronic equipment used on rolling stock*. Evidence of compliance with equivalent standard IEC 60571 *Railway applications – Electronic equipment used on rolling stock* is accepted as meeting this requirement.

6. **Operating conditions**

All electrical power, control, signal and communication cables shall meet the performance requirements appropriate for the installation for the following conditions:

- rail operations environment
- ambient temperature conditions
- power supply system
- vibration conditions

6.1. **Rail operations environment**

Rail vehicles operate in suburban and outer suburban areas which include tunnels and elevated track.

The operating and design categories shall be approved by the authorised contract representative.

6.2. **Environment conditions**

All electronic equipment shall be tested in accordance with EN 50155.

All electronic equipment shall be suitable for use in the climatic conditions and relevant altitude conditions as stated in T MU RS 17001 ST *Environmental Conditions for Rolling Stock*.

The temperature inside an equipment enclosure can rise above the ambient shade temperature by up to 20 °C. This factor shall be taken into account when designing equipment and when selecting electronic components.

For existing non air-conditioned fleets, where fluorescent lighting ballasts are located close to the roof, fluorescent light inverter ballasts shall operate satisfactorily at 90 °C.

6.3. **Power supply**

Electronic equipment shall be designed to operate with supply voltage variations and transients.
6.3.1. Variations and interruptions of voltage supply

Electronic equipment shall perform its functions to specification during variations in supply voltage in accordance with the requirements of EN 50155.

Electronic equipment shall operate normally during periods of voltage interruptions in accordance with EN 50155.

6.3.2. Power supply transients

The equipment shall not be damaged or malfunction in the presence of spikes and surges on the supply, across input or output terminals.

All electronic equipment shall withstand surges, electrostatic discharge and transient burst susceptibility tests as specified in EN 50121-3-2 Railway Applications – Electromagnetic Compatibility – Part 3-2: Rolling Stock – Apparatus in accordance with EN 50155.

6.4. Vibration and shock

Equipment shall be tested for vibration and shock in accordance with the requirements of EN 50155.

7. Design of electronic equipment

All electronic equipment shall be manufactured and designed in accordance with EN 50155.

Software for the electronic equipment shall be developed in accordance with EN 50128 Railway applications – Communication, signalling and processing systems – Software for railway control and protection systems.

The design of electronic equipment shall meet the requirements for the following:

- fire performance
- equipment reliability
- component ratings and derating
- adjustable components
- component tolerances and ageing
- protection
- interference
- ventilation
7.1. Fire performance

The fire performance of all new equipment shall comply with the following requirements:

- T HR RS 17010 ST Passenger Rolling Stock Fire Safety
- T LR RS 17010 ST Light Rail Vehicle Fire Safety

The operating and design categories shall be approved by the TfNSW authorised contract representative.

7.2. Equipment reliability

The required reliability will be specified in the individual specification and the manufacturer shall provide reliability data on the equipment together with any supporting evidence of figures used. No maintenance shall be required to achieve the stated reliability figures.

Reliability shall be evaluated in accordance with IEC 60605-6 Equipment reliability testing – Part 6: Tests for the validity and estimation of the constant failure rate and constant failure intensity.

7.3. Component ratings and de-rating

Component ratings and de-rating shall comply with the requirements of EN 50155.

7.4. Adjustable components

The use of adjustable components should be avoided, unless inherently essential. Designs that incorporate stable fixed components are preferred.

7.5. Component tolerances and ageing

Circuits shall be designed so that cyclic and non-cyclic changes in component values and parameters (which can occur during the operational life of the equipment) are inconsequential or compensated for. Such compensation shall not necessitate the use of adjustable controls.

The combined effects of all tolerances within a single component and between components shall be allowed for, taking into account all tolerances in all worst case combinations produced by environmental and operational conditions.

Other statistical assumptions that only certain combinations of tolerances will occur shall not be made, unless the relevant parameters involved are invariably interdependent.

7.6. Protection

All circuits shall be designed so that in the event of a component fault, consequential damage is minimal.
Outgoing cables shall be rated above the current limit value.

7.7. **Interference**

All electronic equipment shall meet the requirements for the following types of interference:

- self generated interference
- external interference
- radio interference

7.7.1. **Self generated interference**

Equipment shall not generate any type of electrical, mechanical, magnetic, audible or near audible sonic interference or noise at a level that can be detrimental to the performance of any other equipment or that can cause annoyance, discomfort or health risk to any person.

Individual components of the equipment shall not exhibit harmful resonance or perform any unscheduled operation with particular reference to relays and standard miniature circuit breakers.

7.7.2. **External interference**

Where the performance of any equipment can be susceptible to interference it shall be shielded from such interference.

7.7.3. **Radio interference**

Radio interference testing shall be conducted in accordance with the requirements of EN 50155.

7.8. **Ventilation**

Forced cooling is not preferred. However, when forced cooling is required, such cooling shall be compliant with EN 50155.

8. **Construction of electronic equipment**

All electrical equipment shall be constructed in accordance with the requirements of EN 50155.

Additional construction requirements exist for the following:

- component mounting
- electrical connections
8.1. Component mounting

Component mounting shall conform to IEC 61188-1-1 *Printed boards and printed board assemblies – Design and use – Part 1-1: Generic requirements – Flatness considerations for electronic assemblies.*

Additionally, the following shall apply:

- all components weighing 14 g and over shall be adequately supported and secured
- components shall be mounted so that no adverse effects result from the fixing method

8.2. Electrical connections

All electrical connections shall comply with the requirements of EN 50155.

Additional requirements exist for the following connection types and attributes:

- crimped connections
- soldered connections
- internal wiring
- printed circuit boards
- protective finishes
- encapsulation
- ventilation

8.2.1. Crimped connections

Crimped connections shall comply with the requirements of EN 60352-2 *Solderless connections – Part 2: Crimped connections – General requirements, test methods and practical guidance.*

8.2.2. Soldered connections

Soldered connections shall comply with the requirements of EN 50155.

8.2.3. Internal wiring

Internal wiring shall comply with the requirements of EN 50155.

8.2.4. Printed circuit boards

Additionally printed circuit boards shall comply with the requirements of IEC 61188-1-1.

Edge connectors for printed circuit boards shall not be used.
8.2.5. **Protective finishes**

Protective finishes shall comply with the requirements of EN 50155.

8.2.6. **Encapsulation**

The methods of making connections through the encapsulant shall not permit the ingress of moisture.

The encapsulation process shall, so far as is reasonably practicable (SFAIRP), ensure that the finished product is free from cracks, air pockets and any weaknesses due to any components that are too near to the surface.

8.2.7. **Multi-pole circular connectors**

The design and arrangement of multi-pole circular connectors shall be such that incorrect mating cannot occur. Where more than one connector is available, incorrect insertion shall be prevented.

Gold plated mating pins and sockets to a minimum thickness of two microns shall be used.

9. **Identification**

All electronic equipment and its installation shall be identified through the following:

- labelling of equipment
- identification of mounting position
- identification of components

9.1. **Equipment labelling**

Labelling of equipment shall facilitate routine testing and maintenance. All labels shall be clear, bold, concise, durable and securely fixed.

Each detachable unit shall be either marked so as to enable it to be identified with the parent equipment, or else marked with the manufacturer’s name, type number or code number and its function.

Each printed circuit board shall carry its circuit function title and serial number.

9.2. **Unit and sub unit mounting position**

Each mounting position shall be marked to indicate the type of unit or sub-unit to be located in that position. Additional markings may be required for near identical units or sub-units having different preset characteristics.
9.3. Termination of screened cables

The functional requirements of the circuit are to determine the termination of the screened cables; that is, whether one or both ends of the screen are terminated to earth.

10. Component identification

Component reference numbers shall be marked adjacent to the components. On closely packed circuits the reference may be placed such that it can be seen when the component is removed.

The following shall be marked in all instances:

- fuses – the type rating and the circuit identification of each fuse shall be marked adjacent to the fuse base
- control and indicating devices – the function of each control and indicating device and its mounting position
- preset controls – the circuit reference and if possible the function shall be marked adjacent to each preset control and in a position where it will be clearly visible while the adjustment is being made
- connectors – the diagram reference number shall be marked on the connector or adjacent to each connector
- test points – the diagram reference number prefixed by 'TP' shall be individually marked adjacent to the test point
- polarised devices, for example, diodes and transistors – the polarity of any polarised devices shall be indicated
- heatsinks – the polarity (that is, A or K) of heatsinks shall be identified adjacent to device fixing

11. Documentation

All documentation shall be supplied in accordance with EN 50155.

The number of copies required shall be specified in the contract.

Documentation shall be provided for all modifications made during the warranty period. Such documentation shall include changes to all relevant sections of the literature.

12. Testing

Where not otherwise specified within this standard, all testing shall be in accordance with EN 50155.